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DISTRIBUTION OF *ERIGERON PUMILUS* AND *E. CONCINNUS* (ASTERACEAE: ASTEREAE) IN COLORADO, NEW MEXICO, AND ARIZONA

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ABSTRACT

The geographic ranges of *Erigeron pumilus* var. *pumilus* and *E. concinnus* are essentially parapatric in Colorado, northwestern New Mexico, and adjacent Arizona. The two taxa flower at the same time and occur in similar habitats, but putative morphological intermediates are rare. Their close, non-overlapping distribution is analogous to that of *E. pumilus* var. *intermedius* and *E. concinnus* in Nevada.

KEY WORDS: *Erigeron pumilus* var. *pumilus*, *E. concinnus*, Astereae, Colorado, New Mexico, Arizona

A sharp morphological and geographical demarcation in Nevada between *Erigeron concinnus* (Hook. & Arn.) Torr. & Gray and *E. pumilus* Nutt. var. *intermedius* Cronq. was regarded as evidence that the taxa are reproductively isolated, the former thus appropriately treated at specific rank (as *E. concinnus*, rather than *E. pumilus* var. *concinnoides* Cronq.; Nesom 1983).

Erigeron concinnus along its eastern border approaches the range of typical *E. pumilus*, and Cronquist noted (1947, p. 183) that these two "behave almost if not quite as distinct species, where their ranges meet." Harrington (1954, 570) also was aware of their distinction, noting that typical *E. pumilus* in Colorado was "all east of the Continental Divide," while *E. concinnus* was known from records "scattered in the western one-fourth [of the state]." The current study examines examines in detail the distributions and potential interaction between these two taxa, paralleling the earlier study (Nesom 1983) of *E. concinnus* and *E. pumilus* var. *intermedius*.

The three taxa under consideration are distinguished by contrasts in the following key (modified from Nesom 2006).

1. Disc corollas hirsute-strigose with sharp-pointed hairs; outer pappus of scales 0.2–0.5 mm long, inner of (7–)10–14(–15) bristles ..... **Erigeron concinnus**
1. Disc corollas glabrous or slightly puberulent with glandular-viscid, blunt-tipped hairs; outer pappus of setae or subulate scales, 0.1–0.3 mm, inner of 12–27 bristles ..... **Erigeron pumilus**

2. Outer pappus of coarse bristles or setiform scales, inner of 12–20 bristles; rays usually pink, sometimes white; indurate portion of disc corollas glabrous or slightly puberulent, relatively dull ..... **Erigeron pumilus** var. **intermedius**
2. Outer pappus of inconspicuous, well-developed setae, inner of 15–27 bristles; rays white; indurate portion of disc corollas glabrous, shiny ..... **Erigeron pumilus** var. **pumilus**

Figure 1 shows the total geographical distributions of *Erigeron concinnus* and the two varieties of *E. pumilus*, as currently understood.

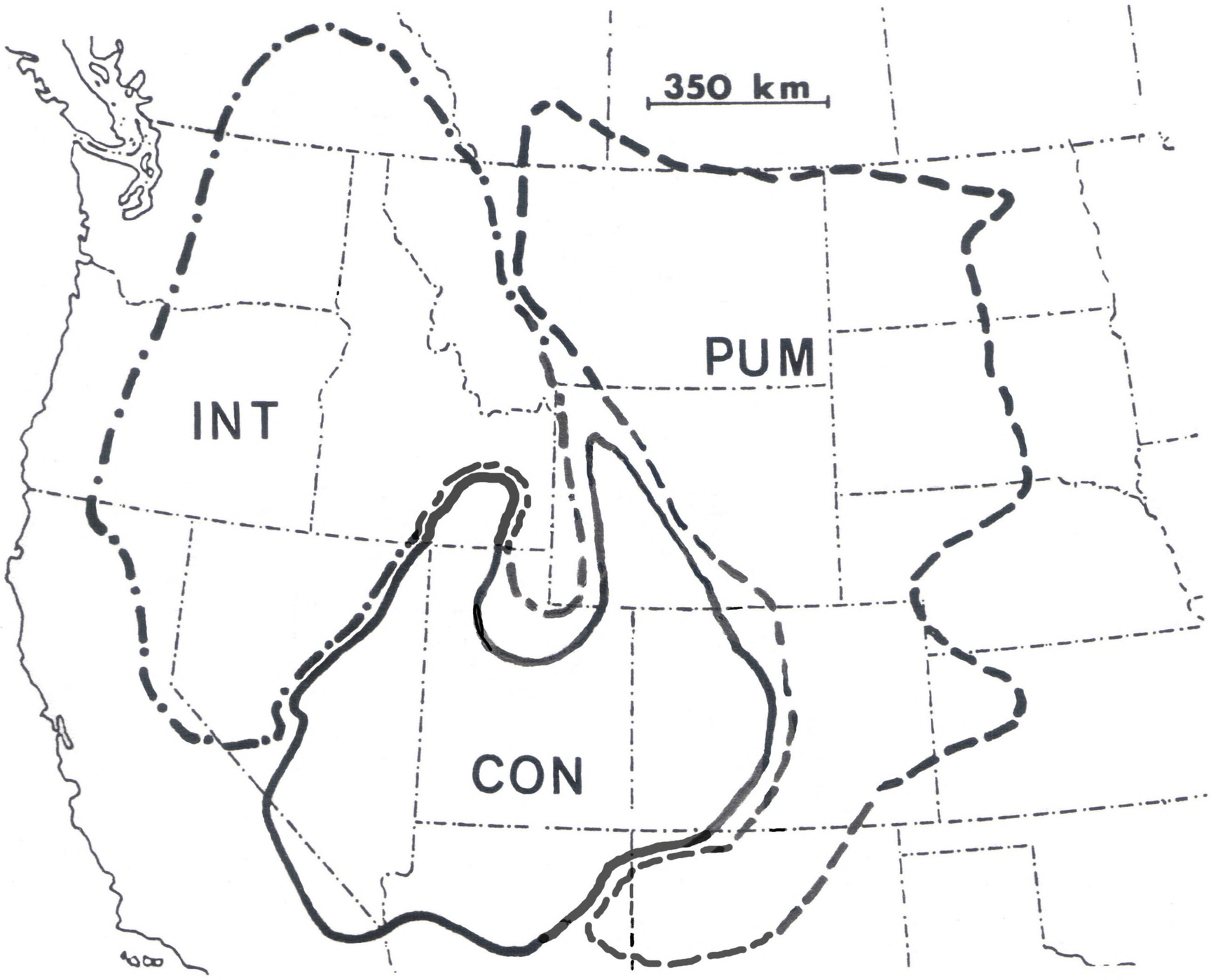

Figure 1. Generalized distributions of *Erigeron concinnus* (CON), *E. pumilus* var. *pumilus* (PUM), and *E. pumilus* var. *intermedius* (INT). Modified from Figure 1 in Nesom (1983), with var. *pumilus* now shown extending south into New Mexico and Arizona and further north in Wyoming.

The present study is primarily based on specimens examined from BRIT-SMU, NY, TEX-LL, and UNM (herbarium visits) and NMC and SJC (loans). The online specimen database from herbarium COLO has been used to complete Colorado distributions; recorded annotations by W.A. Weber usually indicate the nature of the outer pappus ("outer pappus of scales" = *E. concinnus*, or "outer pappus of bristles" = *E. pumilus*). Vouchers for New Mexico and Arizona are cited; those for Utah and Colorado are from BRIT, NY, SJC, TEX, and Cronquist (1947).

Results and discussion.

The geographic relationship of *Erigeron concinnus* with *E. pumilus* var. *pumilus* is analogous to its relationship with *E. pumilus* var. *intermedius*. *Erigerons concinnus* and var. *pumilus* are essentially parapatric in Colorado, New Mexico, and Arizona (Fig. 2), as are *E. concinnus* and var. *intermedius* in Nevada. In northwestern New Mexico, where the two taxa occur in closest proximity, intermediates are uncommon to rare (see below), suggesting that some degree of reproductive isolation exists. The same pattern of parapatry continues northward through Wyoming (see Rocky Mountain Herbarium 1998, with some modifications in identifications, fide Ron Hartman).

In documentation of the closely associated ranges in new Mexico, specimens studied from that state are cited here (Appendix 1). Because the occurrence of typical *Erigeron pumilus* in Arizona has been uncertainly known, records for it also are cited here (Appendix 2).

The close parapatry of *Erigeron concinnus* with the two expressions of *E. pumilus* is remarkable. In San Juan and Rio Arriba counties, New Mexico, where *E. concinnus* and var. *pumilus* closely approach each other, the San Juan River roughly marks a boundary between them but they flower concurrently and grow in similar habitats and an ecological factor that might be responsible is not apparent. Competitive exclusion seems unlikely.

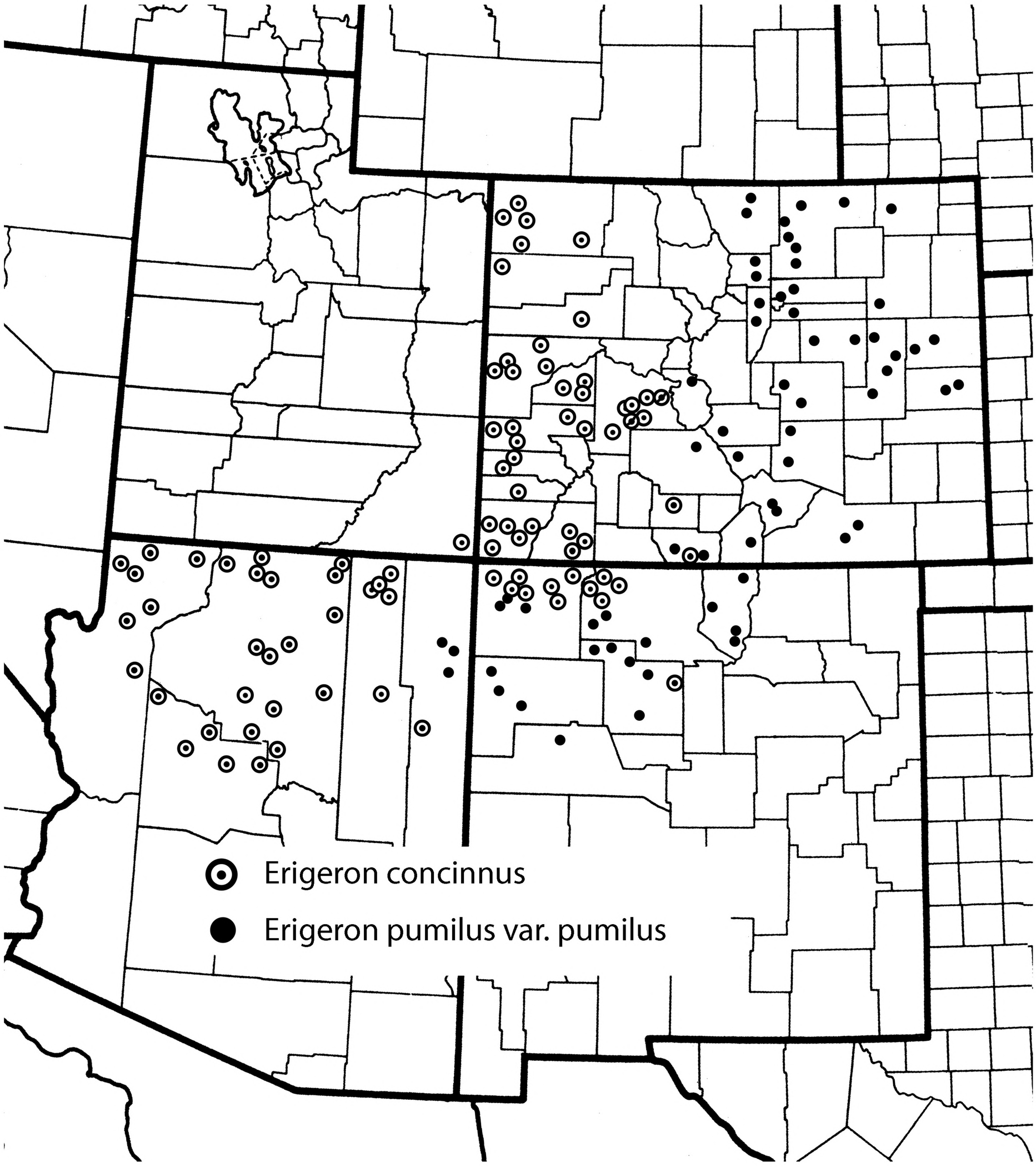

Figure 2. Geographic distribution of *Erigeron pumilus* var. *pumilus* and *E. concinnus* in Colorado, New Mexico, and Arizona. The slashed *E. concinnus* symbols in Gunnison Co., Colorado, are plants with very narrow scales. The out-of-range collection of *E. concinnus* from along the Rio Grande River in Sandoval Co., New Mexico (*Heller 3632*), possibly was a waif.

A chromosome number of $2n = 18$ has been reported for *Erigeron concinnus*, $2n = 18$ and $2n = 36$ for var. *intermedius*. Apparently no report exists for var. *pumilus*. In any case, it would not be surprising to find more than one ploidy level in each of the three, given the high frequency with which polyploidy occurs in the genus, and a cytological study might provide useful biological insights. Even if different ploidal races were parapatrically aligned, however, it seemingly would not account for the sharp boundaries.

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Appendix 1. *Erigeron concinnus* and *E. pumilus* var. *pumilus* in New Mexico.

Erigeron concinnus. Rio Arriba Co.: BLM, near Gobernador, along gas line N of the El Cedro Compression Station, ca. 1 mi NW of the Gobernador Camp, sagebrush with scattered juniper, 18 May 1993, *Heil & Melton 7484* (SJC); Delasso Loos Road, 9.3 mi E of NM 539, large old pinyon-juniper woodland, Russian olive, rabbitbrush, and willow, gray clay soil, 1 Jun 1997, *Reeves 9308* (SJC); mouth of Cottonwood Canyon, Lower Bancos Canyon, pinyon-juniper, clay to sandy soil, 1950 m, 28 May 1987, *Wilken 14739* (NMC). Sandoval Co.: 19 mi W of Santa Fe, along banks of the Rio Grande River, 5450 ft, 31 May 1897, *Heller 3632* (MO, NY). San Juan Co.: Aztec, 28 Apr 1899, *Baker 664* (MO, NY, RM, US, fide Cronquist 1947); B-Square Ranch, Head Canyon ca. mi S of outlet, talus, 5340 ft, 25 May 1999, *Heil 13011* (SJC); Bloomfield, N of town on "B" Hill, 9 May 1982, *Howd 16*[2032] (SJC); The Badlands, W of Farmington, ca. 1 mi W of the La Plata River, 23 May 1984, *Porter 84-214* (SJC); Bloomfield [area], N side of Kutz Canyon, 3 May 1985, *Porter 1018* (SJC); Co. Rd. 3590, 1.8 mi N of NM 574, jct 5 mi NW of Aztec, badland ridges, open pinyon-juniper woodlands, 6260 ft, 17 Jun 1997, *Reeves 9403* (SJC); Pump Mesa, access from NM 511, gas well 236, pinyon-juniper woodland, sandy clay soil, 17 May 2000, *Reeves 10090* (SJC); Farmington, 19 Jun 1911, *Standley 7096* (US, fide Cronquist 1947).

Erigeron pumilus var. **pumilus**. McKinley Co: ca. 6 mi W of Torreon and ca. 2.5 mi E of Ojo Encino, desert shrub community, silty-clay, ca. 5700 ft, 6 May 1995, *Clifford 95-117* (SJC); Navajo Nation, 4.5 mi E of Coyote Canyon community [Brimhall P.O.], scattered juniper, big sagebrush, rabbitbrush, 6630 ft, 17 May 2000, *Clifford 00-249* (SJC); Navajo Indian Reservation, just W of Ojo Encino School in sagebrush flats, sandy-clay soil, 6800 ft, 30 Jun 1988, *Heil 4486* (SJC); Navajo Nation, 1.5 mi down Wildberry Canyon [ca. 5 miles ESE of Coyote Canyon Store], savannah with pinyon, juniper, ephedra, Yucca, sandy, 7066 ft, 17 May 2000, *Heil et al. 14579B* (SJC); N of Continental Divide community, pinyon-juniper, red sand with gypsum, 7500 ft, 12 Jun 1991, *Hevron*

1258 (TEX); NW of Ojo Encino near the Continental divide, sagebrush flat, 2127 m, 24 May 2000, *O'Kane & Heil 4635* (SJC). Rio Arriba Co: ca. 0.5 mi N of jct Forest Service Roads 314 and 315, Carson National Forest, Jicarilla District [ca. 13 miles S of US 64 and ca. 1 mile E of the Jicarilla Apache Reservation, ca. 25 miles SSE of Navajo City], ponderosa pine, juniper-oak, 9 Jun 1995, *Clifford 115* (SJC); Navajo Canyon, 4.5 mi SW of Canjilon, sagebrush-Pinus edulis, 7400 ft, 14 Aug 1963, *Goodrow 694* (UNM); Largo Canyon Road near mouth of Rincon Largo, slopes above the wash and in wash, clay soils on slopes above and sandy alkaline soils in wash, 1936 m, 5 Jun 2000, *Heil & O'Kane 14731* (SJC); Jicarilla Apache Reservation, Largo Canyon, Adobe Knobs area, 1 mi E of NM 537, ca. 6 mi S of 6th Std. Parallel North, pinyon-juniper community, clay, 18 May 1995, *Holmes 93* (SJC). Sandoval Co.: Jicarilla Apache Reservation, road across from rest area at jct 537 and 44, first dirt road to left, ca. 1 mi, 6 Jun 1995, *Holmes 296* (SJC); Mule Dam area, desert scrub community, 6 Jun 1995, *Holmes 313* (SJC); exactly 20 NW of Cuba along NM Hwy 44, , ca. 1/2 mi E of NM 537 (Lindrith/Duke road), 1/4 mi S of hwy, S side of mesa, on S slope over badlands, *Artemisia tridentata*, in sand, 4 Jun 1984, *Spellenberg 7792* (NY, TEX); NM Hwy 44, 20 NW of Cuba, ca. 1/2 mi S of hwy on W side of mesa, between badland ridges and extending weakly into loamy, alkaline soil, among sagebrush, 7000 ft, 29 May 1986, *Spellenberg 8490* (NY, TEX). San Juan Co.: Dufer's Point, 10 mi NE of Huerfano Mt., sagebrush community, with *Hilaria jamesii*, *Bouteloua gracilis*, *Artemisia tridentata*, loamy clay soil, 1981 m, 26 Apr 1987, *Anderson 4114* (NMCR); 1.0 mi W of Chuska Peak, ponderosa pine-oak-juniper, gravelly soil, 4 Jun 2001, *Atwood & Clifford 27599* (SJC); Navajo Reservation, 6.5 mi SW of Nageezi area, shallow sloping topography above Kimbeto Wash, scattered pinyon-juniper, eolian deposited sand sheet, ca. 6900 ft, 25 May 2000, *Clifford 00-354* (SJC); Navajo Nation, Tertiary terrace 1.5 mi SW of San Juan River-Hogback Monocline crossing, galleta and Indian rice-grass community, silty to sandy soil, 5170 ft, 11 Jul 2000, *Clifford 00-738* (SJC); Cutter Dam, 4 Jun 1995, *Holmes 285* (SJC); San Juan College [Farmington], Fred Edwards Nature Trail, pinyon-juniper woodland, alluvium, 5700 ft, 4 May 1988, *Jenkins & Smith 45* (SJC); Navajo Indian Reservation, NIIP, S13 T27N, R16W [ca. 28 miles WNW of Farmington], desert shrub, 1 Jul 1988, *Mietty 3114* (SJC); BLM, Angel Peak area S of Bloomfield, sagebrush community, sandy soil, 6185 ft, 19 May 1992, *Sawyer 45* (SJC). Taos Co.: 18 mi S of Ranchos de Taos on Hwy 68 at historical marker, 8 Jun 1979, *Holm 16* (BRIT); 5.9 mi W of Penasco on Hwy 75, 8 Jun 1979, *Pierce 12* (BRIT); N of Arroyo Aguaje de la Petaca, among sagebrush along power line, 31 May 1978, *Spellenberg 4986* (NMC, NY).

Appendix 2. *Erigeron pumilus* var. *pumilus* in Arizona.

Erigeron pumilus var. **pumilus**. Arizona. Apache Co.: Navajo Reservation, W Chuska Mtns., ca. 2.25 mi E of Wheatfields Lake and 1.5 mi NE of White Cone Peak [New Mexico], ponderosa pine with big sage, silty clay to silt, 7850 ft, 4 Jun 2001, *Clifford & Atwood 01-596* (SJC); Defiance Plateau, 7 Jun 1937, *Peebles & Smith 13446* (LL, US fide Cronquist 1947); Canyon de Chelly National Monument, west shore of Tsaile Lake on gravelly, sandy soil, 23 May 2001, *Rink 421* (SJC).